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ABSTRACT Public participation in technological decision-making is increasingly seen as de rigueur, but the limits and purpose of such participation remain open to debate. In this paper we explore the tension between different rationales for widening participation and examine their implications for its practice. Taking debates about medical genomics in the UK as an illustrative example, we argue that more heterogeneous participation and debate have the potential to improve the scrutiny and accountability of science within representative democracies. In doing so we also argue that it is necessary to replace the language of 'lay expertise' with a more systematic and rigorous treatment of the expertise or its absence that characterizes different participants. Drawing on the theoretical work of Collins & Evans (2002), we distinguish between those processes where expert knowledge is required and debate is conducted within the public domain, rather than by the public itself, and those where the views of non-expert lay citizens are needed and valued. The effect of adopting this approach is to permit a more inclusive treatment of the 'technical' while also providing a positive role for non-expert citizens in the democratic control and oversight of science.

Keywords democratizing science, expertise, public engagement with science and technology, public participation

Listening Without Prejudice?

Re-discovering the Value of the Disinterested Citizen

Robert Evans & Alexandra Plows

> Society needs to do a better job of asking what kind of tomorrow we create with the possibilities that science offers. Such decisions are governed by values, beliefs, feelings; science has no special place in such democratic debates about values. But science does serve a crucial function in painting the landscape of facts and uncertainties against which such societal debates take place.[1]

> Expertise is constituted within institutions, and powerful institutions can perpetuate unjust and unfounded ways of looking at the world unless they are continually put before the gaze of laypersons who will declare when the emperor has no clothes. (Jasanoff, 2003: 397–98)

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Science and Technology Studies (STS) scholars have done much to promote the view that public participation in decisions relating to science and technology is a good thing. In the UK and European Union (EU) the effectiveness of these arguments can be seen in policy documents that recognize the importance of soliciting opinions from stakeholders, concerned citizens and the wider public (for example, the Royal Commission for Environmental Pollution, 1998; House of Lords, 2000; Parliamentary Office of Science and Technology, 2001; Gerold & Liberatore, 2001; Hargreaves & Ferguson, 2001; Office of Science and Technology, 2002; Wilsden & Willis, 2004; Council for Science and Technology, 2005). In the USA the practice is also well entrenched, with Jasanoff (2003: 397) reporting that in 'regulatory decision- making, for example, all federal agencies are required by law to engage the public at least by offering notice of their proposed rules and seeking comment'.[2] The argument for increasing participation thus seems to have been won, at least in principle. The problems that remain relate to the practical issues of how and when to organize such participation and what to do with the outputs of such events when they are completed.

STS has also had much to say about these practical issues. For example, there are many studies documenting and, to varying degrees, evaluating the extent to which existing policies or institutions give lay citizens an effective voice (cf. Hilgartner, 2000; Irwin, 2001; Rayner, 2003; Jasanoff, 2005). More relevant for this paper is the body of work that derives from STS but seeks to operationalize its ideas in the design of new institutional practices such as Constructive Technology Assessment (Rip et al., 1996) or Interactive Technology Assessment (Grin et al., 1997).[3] In this paper, our aim is to contribute to this latter strand within STS by reflecting critically on the idea of 'public participation' and asking who might take part in such exercises, what they might do and what might legitimately be claimed for their efforts. In particular, we use the typology of expertise proposed by Collins and Evans to distinguish between the different types of problems that might be addressed and examine the different contributions that experts and non-experts can make to their debate in different forums.[4] As a result, our argument is both prescriptive and descriptive – we use data from our own research and observations of participatory experiments to describe the different types of expert we encounter, but also to consider more prescriptively the kinds of decisions for which such expertise can be seen as appropriate.

Our argument proceeds in three stages. First, we show that the distinction between 'scientists' and 'publics', on which much of the discourse surrounding public participation is predicated, is misleading. 'Scientist' is too narrow a category, while 'public', even when pluralized as 'publics', conflates groups that are quite distinct. Categories are still needed, however, and we argue that a more useful way of thinking about the potential participants in a consultative or deliberative process is to distinguish between *experts*, who may be scientists, activists or others with relevant specialist experience, and *lay citizens* or *non-experts*, who have no particular expertise bearing upon the problem beyond that acquired in everyday life.[5]

While it is true that experts will also be citizens somewhere and lay people in relation to other debates, the crucial argument is that in any specific case a citizen cannot be an expert and a non-expert at the same time. Moreover, it is only those who are non-experts with regard to the science in question who can authentically represent the lay perspective implied in calls for the democratization of science.

Distinguishing between experts and non-experts, rather than scientists and publics, has two consequences for participation. First, it increases the range of individuals who can – and should – contribute to an expert debate. As the STS literature has shown, there are many ways in which including additional perspectives and sources of expertise enables a more searching examination to be conducted. For example, the assumptions and reliability of current science are more fully tested, knowledge that is unavailable by other means is articulated, and the values and future visions implied in different knowledge claims are made explicit (see for example, Jasanoff, 1990, 1995, 2005; Epstein, 1996; Irwin & Wynne, 1996; Wynne, 1996; Busch et al., 2004).

Second, the difference between the two categories highlights the way in which holding an expertise that is not ubiquitous undermines claims to be speaking for 'citizens in general'. Instead, individuals with specialized expertise are more accurately seen as representatives of particular epistemic communities, such as 'scientists', 'farm-workers', 'environmental activists' or 'agribusiness', and so on. Such groups may speak 'to' the members of the wider society but cannot claim to speak 'for' them. This, in turn, raises a new challenge because widening participation by democratizing science usually means more than giving expert groups a voice in the public domain. In most cases, 'doing democracy' means considering how this clash of more or less expert interest groups relates to the concerns of the broader non-expert or lay citizens who are excluded by the invocation of expertise.[6]

Having thus argued for a more heterogeneous but not unlimited category of expert, our aim in the third and final section of the paper is to consider lay or non-expert participation as a separate process and, using the example of the citizen jury, offer a more positive assessment of how the gap between 'democracy' and 'expertise' can be bridged. In particular, we argue that the relative disinterest of non-expert citizens should be seen as a virtue rather than a problem. By disinterest, we mean the lack of engagement and detailed knowledge that distinguishes non-expert citizens from the more committed standpoints of the various expert groups. This sense of the word differs from the way Merton (1973: 277) uses 'disinterestedness' to refer to the normative integrity of an expert scientific community. In our usage, it is the *absence* of specialist expertise that marks 'disinterestedness'; it is the lack of any prior, or special, interest in what the experts know and care about. The reason for this is that, even if it is accepted that expert forums remain the most suitable institutions for resolving complex and contested matters of fact, there remains a need – identified by STS and reflected in the wider society – for these activities to be undertaken within

the context of a broader public scrutiny. The citizen jury model, with its implicit distinction between 'expert witnesses' and 'citizen jurors', provides one mechanism through which such deliberation and scrutiny by non-expert (that is, lay) citizens can be encouraged.

Theorizing Expertise

In approaching the question of how public participation can be analysed and accomplished, we have chosen to use the expertise of participants as an analyst's category rather than an actor's category. In taking this approach, we recognize that we are doing something different from the style of STS research in which the actors' accomplishment or denial of expert status is the research focus. Nevertheless, if STS is to contribute to debates about the mechanisms through which expert knowledge is to be put before lay-persons, it seems important to have a working definition of what constitutes a layperson and some rationale for the process through which such people should be given a voice. In what follows, we use the theoretical framework set out by Collins & Evans (2002) to classify the kinds of expertise we find in our own research data, and then relate these findings to the wider body of research on participatory forums, particularly citizen juries. In doing so, we begin to operationalize the distinction between the 'technical' and 'political' phase of a debate proposed by Collins and Evans, and describe some criteria through which the appropriate participants for each can be identified. We begin by summarizing the main kinds of expertise identified by Collins and Evans and their relationship to different kinds of decisions.

Types of Expertise

Collins & Evans (2002) set out a basic categorization of expertise in which substantive expertise about a domain of activity is divided into three types: *no* expertise, *interactional* expertise and *contributory* expertise.[7] Roughly speaking, these correspond to knowing nothing about the activity, being able to converse intelligently about it and being able to contribute fully to the life of the relevant community.[8] In addition, the paper also identified some forms of meta-expertise that might be used to make judgements about the expertise of others, the most important of which for this paper is *discrimination*. Since the publication of the (2002) paper, the theory has developed to include a more nuanced set of categories and to highlight more clearly the difference that immersion within a form-of-life makes to the kinds of expertise that can be acquired (see Collins & Evans, 2007).[9] The new categorization is summarized in Table 1, and the most important distinctions for our analysis are as follows.

First, the category of 'no expertise' has been subdivided to recognize the degrees of expertise that exist between full linguistic socialisation (that is, *interactional* expertise) and knowing absolutely nothing (that is, *no* expertise). For example, one might first acquire some basic facts (beer mat knowledge), then a simple, schematic understanding from introductory,

TABLE 1

The periodic table of expertises

UBIQUITOUS EXPERTISES					
DISPOSITIONS	Interactive ability → Reflective ability				
SPECIALIST EXPERTISES	*UBIQUITOUS TACIT KNOWLEDGE*			*SPECIALIST TACIT KNOWLEDGE*	
	Beer-mat knowledge	Popular understanding	Primary source knowledge	Interactional expertise	Contributory expertise
	Polimorphic → *Mimeomorphic*				
META-EXPERTISES	*EXTERNAL*		*INTERNAL*		
	Ubiquitous discrimination	Local discrimination	Technical connoisseurship	Downward discrimination	Referred expertise
META-CRITERIA	Credentials		Experience		Track-record

Note: Source: Collins & Evans, 2007

secondary or popular accounts and, using this, move on to the primary literature for that domain. Because this knowledge can be achieved using largely everyday skills, such as reading, sufficiently determined individuals are able to gain significant levels of expertise without ever meeting a practitioner. What differentiates these kinds of expertise, which are clearly not trivial, from interactional expertise is that interactional expertise also includes the tacit, social and cultural knowledges that are specific to the expert group and which can only be gained through interaction.

The second change is that the concept of meta-expertise has also been refined to include a distinction between those judgements that require specialist 'internal' experience and those that rely mainly on ubiquitous or 'external' experiences. Thus, there are some judgements about expert claims that non-expert citizens can make based on their everyday experiences of living in a particular society. Where these experiences are widely distributed, then Collins and Evans say the expertise they give rise to is ubiquitous. Examples of these kinds of judgements – which are reflected in sayings such as 'if something seems too good to be true, it probably is' – are to be found in the way inconsistencies and interests are detected or questions raised about the credibility of evidence. Although these may result in technical judgements – for example, nuclear power is unsafe; astrology cannot predict the future – these judgements do not rely on a technical understanding of the science or expertise involved. Instead, they rely on widely available social beliefs about the organizations involved and the ways things are done within those institutional cultures.

A similar idea underpins the category of local discrimination, which may be of more relevance for controversies that involve genetics and other sciences. The difference here is that the experiences upon which the judgements

are based are restricted to a particular group or community. To illustrate the idea, Collins & Evans (2002) used the scepticism of people living in and around Sellafield–Windscale – the site of a British nuclear power plant – towards government assurances about safety. In this case, local people discounted scientific assurances from the government about levels of radioactivity because of their understanding of the local context in which accidents and alarms associated with the plant were part of their everyday life. This is not to say that some of these people did not also have considerable technical knowledge as well, but simply to emphasize that extensive substantive knowledge is not strictly necessary for forming a judgement about the trustworthiness of a scientific or other institution. Other criteria, including the track record of the same institutions or the fate of similar claims and promises are available as resources for the communities that have been affected by them, and can be used to support judgements about new events. A more contemporary example, which illustrates the role of shared experience rather than shared geography, is the ability of moderately sophisticated internet-users to ignore email hoaxes without a second thought. In most cases this does not rest on a detailed technical understanding of how computer viruses or scams work. It is simply a consequence of gradually coming to learn that email messages of a certain form tend to be associated with bad consequences.

The other kinds of meta-expertise introduced in the table are less relevant for this paper, and will only be described briefly. The similarity between them, and why they differ from either ubiquitous or local discrimination, is that they all require some socialization within a relevant substantive domain of expertise. Connoisseurship refers to judgements about what is good or bad – judgements that are based on criteria that are internal to the expert domain but can legitimately be made by non-practitioners.[10] While the idea applies most readily to the appreciation of art, the idea of recognizing that something is done well according to the conventions of its own genre can be applied more widely. In contrast, the concept of referred expertise recognizes that having expertise in one domain can assist in making judgements about a cognate or related domain. Finally, the idea of downward discrimination signifies the ability to see that another person has made a mistake. As this is a relative judgement, it may not require a vast amount of expertise to make but it can nevertheless be highly effective.

Distinguishing between different types of expertise clarifies the problem of participation by showing that the categories of 'expert' and 'non-expert' cannot map onto the distinction between scientists and non-scientists. It also allows us to ask more precise questions about the kinds of knowledge that experts and non-experts possess, when and how they acquire this knowledge and how these different types of knowledge can be used in different kinds of decision-making processes. For example, being able to distinguish between having or not having expertise allows a debate about which potential experts (whether they are formally accredited as scientists or not) should have their claims recognized. Alternatively, we, as analysts, can turn our critical judgement towards the practice of lay or non-expert participation and ask if ubiquitous skills

and knowledge are an adequate basis for such deliberations. If ubiquitous expertise is not enough, then we must ask what sorts of new knowledge do lay citizens need, how much do they need and how can they acquire it? If, on the other hand, lay citizens do have sufficient expertise, our focus becomes how this knowledge should be solicited and used within the decision-making processes of representative democracies.

Types of Decisions

Our approach to answering these kinds of questions is to ask what kinds of judgements participants are being asked to reach. Collins & Evans (2002) draw a distinction between the 'technical' or expert phase of a decision and its 'political' or democratic phase in order to emphasize the different objectives that participants might have.[11] In the case of the 'technical' phase, participants focus on propositional knowledge, while in the 'political' phase participants address the appropriate framing and interpretation of technical issues or choices. The principal differences between these two aspects of a decision can be summarized as follows.

1. The technical phase relies on expert knowledge (broadly defined) to evaluate the credibility or reliability of knowledge-claims. Although the canonical image of science provides an adequate model of what the aim of such a process should be, particularly with regard to the relative weight that should be given to empirical evidence and rational argument as opposed to attempts by external interests to exert political influence, this is subject to two important caveats. The first is that, because science and technology can no longer be seen as autonomous, the technical issues and choices must be subject to much greater oversight than the canonical model would suggest. The second follows from this recognition of the constitutively social nature of knowledge. Although the primary focus of the technical phase is on the testing of propositions, this is not to say that it is value-free. Rather, the technical phase explicitly prioritizes a specific set of values – those emphasizing the importance of evidence, of reason and so on that are conventionally associated with Mertonian (Merton, 1973) ideals of science – in order to reach its judgements. Recognizing the full range of experts is particularly important in this context because a more heterogeneous set of experts may lead to new forms of evidence being introduced, new standards of proof being accepted or even new domains of expertise being developed.[12]
2. The democratic or political phase refers to a much wider problem than the propositional concerns of the technical phase. It is concerned with the development of the policies and regulatory frameworks within which technical debates are permitted to take place and through which they are held accountable. Its outcome is thus a strategy for action that sets out what should be done, given the uncertainty and controversy exhibited in the technical phase and, ideally, shapes the kinds of research that are prioritized in response to these uncertainties. The outcomes could be

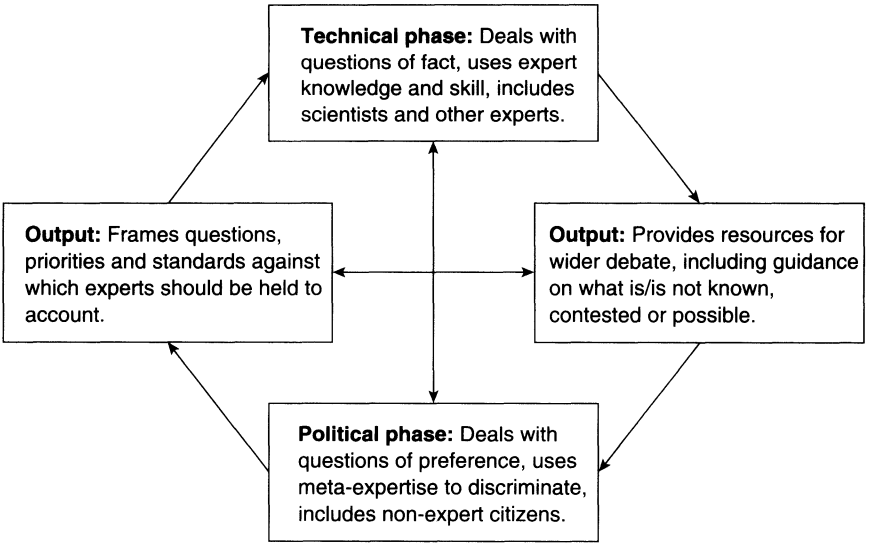
> decisions about the research agenda, which could range from making further research a priority to preventing it altogether, or about the regulation of new technologies, again ranging from placing significant restrictions on its use to making this use a matter of individual choice. While the status of knowledge-claims as perceived by experts is clearly a relevant factor in these debates, the overtly political nature of the debate means that other factors, such as public opinion, economic costs and benefits, and the potential impact on different communities are also legitimate concerns for decision-makers.

Making this distinction does not, however, reintroduce the distinction between facts and values that SSK has so effectively undermined, because there is no assumption that the activities that take place within the technical phase are 'value-free' or 'neutral'. Rather, it enables us to ask, in line with what STS studies from Shapin & Schaffer (1985) onwards have shown: if social, intellectual and moral orders are co-produced, then how can the scientific endeavour be made more accountable and responsive to the wider society in which it is located? Rather than thinking of two separate decisions, taken at two separate times by two separate groups, distinguishing between the technical and political phases highlights the two different, but to some extent complementary, approaches that need to be utilized if the relationship between science and society is to be one in which influence flows in both directions.[13]

The difference between the two phases rests on the kind of question they seek to address and the kinds of norms under which they operate. In the original paper by Collins & Evans (2002), this was characterized by a distinction between intrinsic and extrinsic political influence. In the technical phase, debates are conducted so as to minimize the impact of extrinsic influences, such as appeals to popular opinion or what it is believed that research-funders want to know. In contrast, intrinsic political influence is inevitable and thus, even though it remains, it must be managed. It is at least arguable that including a wider range of experts within the technical phase will actually promote critical reflection about hidden values. In the political phase, different norms apply. In this context, extrinsic political influences are a legitimate input to the decision-making because such matters are the very business of political debate. To give a simple example: while it would be inappropriate for a scientist or other expert to design their research and select evidence in order to reach a predetermined conclusion, it would be acceptable for a regulator to impose severe restrictions because of strong public opposition or concern about some new technology. The kind of contribution the technical and political phases make to the promotion and regulation of technological innovation is summarized in Figure 1.

The relationship between the two phases, and the extent to which they can be discerned in debates around genomics in the UK is explored in more detail in the remainder of the paper, which draws on a series of in-depth interviews with activists seeking to mobilize around medical genetics within the UK. These interviews were conducted as part of the CESAGen

FIGURE 1
Relationships between technical and political phases



'Emerging Politics' project, and thus were complemented and informed by the longer-term ethnographic project of which they are a part.[14] We begin by considering the expertise of those most actively engaged in the debates about genomics and argue that there are good reasons for advocating a more heterogeneous conception of expertise that would recognize the presence of substantial technical knowledge outside the scientific community.

Participants in the Technical Phase: Separating Ignored Experts from Lay Citizens

The expert/technical phase of a decision refers to something quite specific. It is a process – probably a lengthy one – that seeks to arrive at an agreed understanding of some aspect of the natural world. Although this may sound like a call for traditional scientific research, the existing STS literature shows why more of the same will not do. Once the social and cultural nature of scientific worldviews are recognized, and scientific disciplines appear more value-laden and partial in their perspectives, so the rigid boundaries around institutionalized science start to disappear and new groups of epistemologically similar counter-experts become visible. In the context of a technical debate, therefore, widening participation does not mean including more scientists or including more citizens. It means including more *experts*.

It follows from this that the defining characteristic of the participants in the technical phase of a debate is that they have some relevant expertise, which in turn means that they have some sustained experience in that domain.[15] Focusing on experience avoids making every citizen an expert, but does not limit expert status to qualified scientists and other credentialed

experts. From this perspective, scientists are recognized as experts not because of their qualifications but because of their sustained engagement with a particular topic or issue (see, for example, Miller, 2001). By the same argument, because many of the claims to relevance and knowledge made by patient groups, social movements and other 'organic experts' (Plows, 2003) are grounded in a similar sustained engagement, their claims to expert status cannot be dismissed simply because they lack formal certification.

Using experience as the criterion for participation means the traditional participants in 'expert' debates are complemented by new participants, some with scientific backgrounds and some without. In the debates about genetics emerging in the UK, it is clear that several of the more high-profile 'counter-expert' groups are led by people with considerable expertise in various aspects of the science. For example, Greenpeace, GeneWatch and Human Genetics Alert all emphasize their technical expertise in scientific disciplines. In addition, our own research has also shown that individuals within social movements also possess substantial technical expertise. Some activists hold higher and even research degrees but many others have acquired significant expertise 'on-the-job', knowing only too well that understanding the science is necessary to legitimate their own contributions: '[One difficulty] was definitely the language, and the feeling that we weren't experts: we had no right to speak on the issue, that they would always beat our argument; all those issues came into it.'[16] In approaching genetics, activist groups recognized that they needed to increase their knowledge if they were to engage effectively and set about educating themselves accordingly (cf., Epstein, 1995, 1996). They did this in ways that have much in common with the scientific communities they want to engage with and ultimately challenge:

> We got together and ... different people in the group wrote essays and did bits of research. So one lass, who's a doctor, did the basics on what genetics is, to get people au fait with the language. Someone else did one on transgenics, the use of animals in transplants ... but the best thing, [the one] that we were most satisfied with, we met with a group of disabled activists who had already taken action against [the Centre for Life in Newcastle].[17]

Later on, these essays were brought together in a booklet, which in turn informed a 2-day event attended by the activists and other groups, at which issues around genetics were debated and the collective knowledge of the activist network consolidated.[18] Significantly, this attempt to gain substantive expertise drew upon formal, written knowledge and the informal, tacit knowledge gained through social interactions with experts, including both the technical expertise of campaign groups like Human Genetics Alert and the embodied expertise of the disability rights activists. An indication of the range of groups and organizations that are active in debates around genetics in the UK, and which we have encountered during our research, is given in Table 2, which shows how groups with different interests and backgrounds have converged around genomics and, in particular, issues such as genetic screening and databases.

TABLE 2
'Cluster' of critical civil society groups

Substantive focus	*Primary strategies are public information campaigning, policy and lobbying*	*Primary strategy is direct action*
Environmental campaigns (focus on 'green' genomics)	Norfolk Genetic Information Network, Friends of the Earth, Women's Environmental Network, Greenpeace	Earth First!, Global Eco Village Network, Totnes Genetix Group, GreenPeace, GeneNo, Autonomous activist networks
Anti-globalization (focus on anti-corporate, social justice and sustainable development)	Corporate Watch, ETC (Action Group on Erosion, Technology and Concentration), ITDG (Intermediate Technology Development Group), ESSF (European Science Social Forum Network)	Dissent, Peoples' Global Action, Anarchist and other affinity groups
Genetic and related 'watchdog' organizations	GeneWatch, Human Genetics Alert, The Corner House, EcoNexus Liberty, Consumers' Association	
Disability rights		Disability Awareness in Action, Disabled People's Direct Action Network
'Critical' science	Institute of Science in Society, Open Source Bioinfomatics, Scientists for Global Responsibility	

Although many activists may not possess formal certificates to validate their claims to expertise, they have, as a result of their prolonged engagement with a particular debate or controversy, developed substantial interactional expertise in these areas. That they do develop such expertise is evidenced by the sustained and detailed technical critiques made by activist groups in which they use peer-reviewed scientific literature to, for example, question the link between genetic information and the subsequent development of many common diseases implied by the proponents of genetic testing.[19]

Finally, it is important to remember that the activist and scientific communities do not exist in separate universes. Activists, in particular, monitor scientific innovations in a range of ways. In some cases, specialist organizations do the hard work of tracking research and policy. In other cases, continued personal contact with the scientific community provides a valuable resource through which 'insider' knowledge filters back to the wider network. Expert-activists thus act as 'boundary shifters' (Pinch & Trocco, 2002), moving between different social networks and, sometimes, crossing these boundaries in unexpected places:

> I've got lots of informal ties with kind of – well, activists, scientists doing stuff at the [Research Institute], people in my old lab doing medical genetics. I'm

> also a life model as well and a lot of biologists and medics like to draw, and especially when they get older, because, they've always wanted to draw and paint. So, you know, they've headed labs and stuff all their lives and [then] they retire and keep a hand in at the lab and draw. And so I get kind of ... chatting to these people, you know, you mention some place and he goes 'Oh yes, I used to be director of that!'[20]

This constant networking, dissemination and research is a key part of what activists do, and viewed this way the activist community is much like the scientific community – networks are very close, ties are invariably personal, the production and circulation of texts is endemic and there are regular meetings where membership is displayed and confirmed.[21] There are also strategic attempts to organize and influence politicians and research funders, with the European Science Social Forum that formed during the European Social Forum meeting at London in October 2004 being a notable example.[22]

Recognizing these similarities provides a rationale for a more inclusive approach to expert debates in which questions relating to risk or safety could be addressed in terms that meet both the standards of mainstream science and the concerns of those citizens and stakeholders most directly affected. Clearly this process will take considerable time, so recognizing a question as an expert/technical one does not solve the immediate problem of what the regulatory response should be. Nonetheless, including additional expert representation within the long-term decision-making should go some way to ensuring public confidence in any recommendations that do emerge as these statements should no longer be seen as the product of a single interest group.

Speaking 'to' not 'for': Ethics and the Limits of Technical Knowledge

Accepting activists as experts by virtue of their experience increases the range of voices and views expressed within expert debate, but it also raises a new problem. How is this new, enlarged and more diverse set of experts to be made accountable and subject to scrutiny by the wider society? As STS has shown, the existing structures of research funding and development already involve the envisioning and creation of particular social futures and the maintenance of specific forms of power, reward and stratification (for example, Hughes, 1983; Law, 1986; Bijker et al., 1987; MacKenzie, 1993; Wajcman, 2004). If activists are experts, like scientists, then this argument should also apply to them, with the differences found in the kinds of socio-technical futures that are being proposed.

These differences are particularly apparent in the case of genetic research, where groups with broadly similar epistemological claims to expertise differ significantly in their value commitments and concerns. To begin with mainstream science, the perception of genomics is of a research agenda that promises progress and improved quality of life through the prevention or cure of disease and disability. Thus, for example, developments

in genetic science are routinely announced as being orientated towards the cure of diseases, including cancer, Alzheimer's and diabetes. The appeal of such arguments to the wider society can be seen in the public support for charities such as Cancer Research UK, Breakthrough Breast Cancer and Diabetes UK. Perhaps because of this dependence on donors to fund its activities, medical research charities have to take their public perception seriously; organizations such as the Association for Medical Research Charities have evolved in order to reinforce the case made by the scientific establishment. As their spokesperson explained:

> We don't think it's appropriate any longer for the anti groups to use very emotive arguments, and us to try and explain in scientific terms what are the potential medical benefits. I mean, that again is a sort of cross dialogue. What we're saying is, you know, this is to save patients' lives, or prevent human suffering, and to do that we will discuss patients, who have actually got case notes and people have got their photographs and stuff. It's something, I think, the scientific community has been reluctant to do, because, you know, it's emotions, and that's not what the scientific community are about. As patient groups, we do [it for them].[23]

In contrast, the critical activist communities see the same scientific and technological innovations as threats to social and economic justice, and thus as developments that need to be resisted if existing inequalities are not to be reproduced or made worse. From this perspective, genetic testing and screening are typically seen as a new form of eugenics. Perhaps unsurprisingly, many of those currently concerned with patenting and other medical research involving genomics were also involved in the earlier protests against the development of genetically modified crops. As such, they tend see the roll-out of genetic science to medical applications as continuing existing trends of control, commodification and domination. Within the UK, one group explained how their concerns about the setting up of a dedicated genetic research centre, the Centre for Life at the University of Newcastle upon Tyne, was motivated by their unease over genetically modified (GM) crops:

> We had a pre-existing group which formed on crops and genetics and when we heard about the Centre for Life coming to Newcastle we thought we had to do something ... At the time we weren't very sure what it was ... [or] which ethical issues were going to be in the forefront, so we spent quite a lot of time just casting about for ideas really for what to do. We felt it was our responsibility to do something.[24]

In this way, existing concerns and capacity were used as the foundation for developing a new, but related, set of activities. Significantly, the activists are clear – perhaps more so than the scientific establishment – that they are working not only to challenge specific applications, but also to change the institutional structures that define the problems to which these technologies appear to be the solution. Thus:

> I mean, what is the problem? ... you basically have an approach to medicine and health care which has been developed entirely focused on expanding the profits of an industry. ... But it doesn't in any way address the needs of the poor and, in fact, it moves development of medicines and so forth away from addressing the real problems that the world has; whether it's, you know, the sort of awful diseases like malaria or African Aids [or] cholera.[25]

As such, campaigners want to draw attention not just to the technical issues of risk and reductionism within genomic science – whether genetic tests really predict individual futures, and so on – but also to the ways in which existing institutions favour the status quo and marginalize other perspectives:

> ... you have Foresight committees, who are deciding the research priorities for new technologies, which weigh up all the UK government's money for research that's going on, and that's made up of a group of academics and industrialists. Already you have got an industrial loading there ... and they're making decisions on how we fund the technologies that actually frame our future.[26]

Taking more experts seriously has two consequences. On one hand, it has the potential to improve the scrutiny of technical knowledge by subjecting it to a more wide-ranging peer review. On the other, it also has the potential to articulate within the public sphere an equally detailed debate about the social, political and institutional priorities that are inevitably bound up with the production of technical knowledge (cf., Latour, 2004). Viewed this way, the nature of expert debate and the limits of the technical phase become much clearer. While expert debate can usefully try to develop robust knowledge about, for example, the relative importance of genetic and environmental factors in the development of specific diseases, there is more to deciding whether or not this is the right question to be asking in the first place. Understanding the limits of expert debate questions the priority given to 'facts' because technical issues are always debated within a broader social context. The important decisions are thus not just the technical ones, but also the socio-technical ones that frame the debate. There is no a priori reason to assume that existing experts and elites are the best bodies for making such decisions. Indeed, as Sheila Jasanoff (2003: 397–98) has written: 'Public engagement is needed in order to test and contest the framing of the issues that experts are asked to resolve. Without such critical supervision, experts have often found themselves offering irrelevant advice on wrong or misguided questions.'

Questions of resource allocation, social justice and future possibilities are not matters for experts alone. Instead, they are more legitimately located within the political institutions of the wider society (even if, in practice, this appears to be a responsibility they are reluctant to accept). As such, the appropriate participants in such decisions are no longer the experts but the non-expert citizens in the society who will be affected by them.[27]

Participants in the Political Phase: Engaging the Disinterested Citizen

Many of the campaign groups are, of course, aware of the political dimension of their work, and make great efforts to put pressure on policy-makers by promoting awareness of their concerns within the public sphere. As one activist explained:

> Each time the Centre for Life has had a big public event, we've always been there ... When there was a royal visit, we went there with a double-headed Queen Mum ... just to cause controversy really ... We had some nice stickers as well, which we'd put up before, which said 'Campaign for real sex' ... We had some quite good interviews with the local press, where they put in relatively accurately what one or two of our spokespeople said.[28]

It is important to recognize what is happening in these activities and how they differ from what goes on within the technical phase. Neither the activists nor the scientists involved are trying to persuade each other about the veracity of a particular knowledge claim. Instead, they are trying to reach the non-expert citizens outside their communities and enlist their voices in support of a view that has experts speaking both for and against it. We can see these activities as an attempt to break out of the regress created by the indeterminacy of technical argument, but, unlike the experimenters' regress, the focus is not on those *inside* the expert community but those on the *outside*.

The relevance of those outside the expert communities for decisions about how to proceed in the face of technical uncertainty is one manifestation of the movement towards democratizing science that STS has helped to stimulate. Put simply: although including more expert voices allows for the explicit articulation of a wider range of socio-technical futures, it does not provide a mechanism for choosing between them. By enabling non-expert citizens to participate in the debate, additional scrutiny is provided and, hopefully, a more robust and legitimate decision will be produced.

The practical implications of this increasing emphasis on widening participation are less clear, however. In relation to the idea of expertise, the status of expert knowledge and its authority are clearly changed by the increasing weight given to lay citizens and their views. Whereas it might once have been seen as part of the expert's role to make decisions that had important social or political consequences, the contemporary role of experts is more problematic. In the democratic or political phase the role of the expert (scientific or otherwise) is to provide evidence, arguments and visions; it is not to take decisions. Instead, elected representatives or citizens themselves must evaluate the evidence and reach a judgement about how to proceed. In practice, the degree of autonomy that citizens have in making these judgements will vary, and may even be part of the problem that needs to be resolved. In some cases, the choice will rest with individuals; in others, it may be managed via professional gatekeepers or national and international regulation. While these decisions may become particularly

complex in debates around the development and application of genetic testing and screening, the main point – that they are debates about the kind of society we wish to live in – is simple enough.

What is more controversial, however, particularly in the context of STS research and its opposition to ideas such as the deficit model, is the role and contribution of non-expert or lay citizens in these processes.[29] As we saw in the earlier sections, activists and scientists with expertise are all committed to particular value positions and hence to the advocacy of different socio-technical futures. The challenge for the democratic/political phase is to find some way of assessing the response of non-expert citizens to expert debates about which they will, almost by definition, be largely unaware. Significantly, there is some evidence to suggest that these concerns are being reflected in policy practice. As noted in the opening paragraph, increasing efforts are being made to include the non-expert lay public in decision-making about complex, emergent and controversial science. In the UK alone, for example, there has been a range of experiments with deliberative and participatory forums in which publics are encouraged to engage with science.[30] While reviewing all such activities would be a paper in itself, three events in which the authors have taken a particular interest, and which illustrate the general points made in this paper, are described briefly below.[31]

- **The GM Nation?**: The GM Nation? Debate was held in the summer of 2003 and was funded by the UK government following advice from one of its advisory committees (Agriculture and Environment Biotechnology Commission, 2001) about the potential for controversy over the commercial growing of GM crops. The GM Nation? Debate itself formed part of a broader review of GM crops organized at the same time, the other elements being a scientific review and an economic review. The Debate was held as a series of public meetings, some organized centrally, but with the majority arranged locally and independently of the official steering committee. Feedback forms were collected at these meetings and there was also a website where individuals could complete and return the same form. Overall, the GM Nation? Debate was a qualified success. More than 670 public meetings were organized, more than 1200 letters and emails were sent to the organizers and more than 36,000 completed feedback forms were returned. Of these, the vast majority were 'generally uneasy about GM' and its implications. If there was a concern about its conduct, however, it was that the views of those who took an active part in the debate differed from those of a 'Narrow but Deep' control group recruited to represent the 'silent majority'.[32] Although this latter group also had doubts, and these doubts tended to harden as they found out more about GM, the 'Narrow but Deep' group was generally less hostile than the active participants and, in particular, more likely to accept claims that GM crops would help farmers in the developing world.
- **Designer Babies**: This was a Citizen Jury held in Cardiff in the summer of 2004 and timed to coincide with a consultation exercise being run by the Human Genetics Commission. The Jury focused on the topic of 'Designer Babies' and, in particular, the kinds of choices that prospective

parents should be allowed to make. It was organized by a Techniquest (a local science discovery centre), the Wales Gene Park and the University of Glamorgan. Unlike the discussion groups in the GM Nation? Debate, the members of the jury were selected by the organizers, who chose to focus on young people aged between 16 and 19 years. As is standard practice within Citizen Juries, efforts were made to recruit a sample that could be seen as inclusive and representing a range of views. In this case, this meant that, in addition to standard variables such as gender and socio-economic status, the organizers decided to include jurors who were still in education and those who had left, jurors who were parents as well as those who were not, and jurors with genetic conditions that might be subject to genetic testing, and hence screening, in the future. The jury began with an introduction to the basic science of genetics and then heard evidence from a range of witnesses arguing for and against different kinds of genetic testing and outlining the different conditions under which the selection of embryos might occur.[33] In general, the jurors supported the use of genetic testing and embryo selection to prevent passing on genetic disorders and to help in the treatment of siblings (so-called 'saviour siblings'). They were more divided, however, as to whether the decision to define the 'suffering' necessary to justify selection should be made for parents by doctors or other experts, or should be left to the parents. For a minority, however, selection on any grounds was wrong and should not be allowed.

- **NanoJury UK**: The NanoJury was also a citizen jury process, this time based in Halifax and organized by the Policy, Ethics and Life Science Research Centre (PEALS) at the University of Newcastle upon Tyne, the Interdisciplinary Research Centre in Nanotechnology at the University of Cambridge, the environmental non-governmental organization Greenpeace, and the *Guardian* newspaper. Unlike the other two cases, the NanoJury was a deliberate attempt at 'upstream' engagement, as it was designed to solicit public opinion about nanotechnology while that research field was still at an early stage. As with the Designer Baby jury, the verdict of the NanoJury was presented as a series of recommendations, some of which received more support from the jurors than others. In general, the 'NanoJurors', who were selected to represent a range of social and demographic groups, found the jury process beneficial and called for more such events to be organized in the future. With regard to nanotechnology, the jurors recommended that the applications supported and licensed should be those that met human and environmental needs and, perhaps most significantly for the development of nanotechnology, that new nano-materials be tested as 'new substances' and not licensed on the basis of what is known about the same materials in their 'macro' form. The report of the NanoJury was presented at a media launch in September 2005 and a copy was also sent to the Nanotechnology Issues Dialogue Group based in the Office for Science and Technology.

In reflecting on these three events, and their implications for non-expert or lay participation more widely, it is important to remember that each event

was subject to its own set of cultural and historical particularities and that these undoubtedly shaped their conduct, outcome and impact. Nevertheless, the fact that they were held at all demonstrates that seeking the views of lay citizens is increasingly being seen as an important and legitimate part of decision-making. Whether this is for reasons of political expediency or democratic principle is open to debate but, from the perspective of STS, it would generally be seen as a desirable activity, with the inclusion of lay citizens likely to broaden the debate and provide the critical supervision needed to keep expert institutions accountable.

While it would be possible to analyse each event in detail, in what follows we focus on the features shared by these events and the challenge that they pose to the way STS theories have typically understood the lay citizen. In particular, the citizen jury process includes two key assumptions. The first is that the jurors and witnesses will be selected strategically so as to represent relevant social groups and interests.[34] Thus, for example, with the 'Designer Babies' jury, it was seen to be important to include jurors who were parents as well as jurors who were not. The second is that the jurors will need time and training to engage with the science. This is understandable because, in any representative sample of citizens, the majority will be relatively uninformed and perhaps even uninterested in topics at the frontiers of scientific research.[35] Thus, for example, in the case of the NanoJury, the jurors met once a week for a couple of months in order to learn about nanotechnology research and the issues it raised for various expert communities. While it is possible to argue that such citizens are perhaps more expert than they realize, it is unlikely that ordinary lay people will know much about complex and emergent techno-scientific fields such as nanotechnology or medical genetics, an inference that is supported by the testimony of the participants themselves as well as recent survey research (for example, European Commission, 2005).

But is the idea that lay citizens are not lay experts really a problem at all? Accepting that lay people are not knowledgeable about many areas of innovative science seems like heresy, but it is little more than the symmetrical application of the critique routinely made of scientists who stray outside their own disciplines.[36] Accepting that lay people lack knowledge is, in fact, the key step towards resolving their role vis-à-vis expert knowledge, because it makes clear that there are two distinct ways to proceed. One option is to emphasize the participation of citizens who are already actively engaged in the debate by virtue of their biographies, employment or participation in campaign activities. To follow this model, however, is to rediscover the problems and limits of expertise described above.

The other model emphasizes the participation of lay people, and thus attempts to achieve something different from the expert debate of the engaged citizens. In particular, it is only by resisting the temptation to elevate ubiquitous, everyday expertises into something more that a properly democratic dialogue can take place. Put bluntly, if citizens have a significant specialized expertise that is not ubiquitous, then they are no longer 'merely' lay citizens but experts. As such, if the intention is to put science

before lay people, then it is only those who stand outside the committed knowledge cultures of both the scientific and activist communities who can operationalize a genuinely *civic* epistemology. Of course, this is not to say that citizen juries are the answer to everything, but it does highlight the paradoxical implication that if lay people are important, then it must be because of their lack of engagement and not their specialist knowledge.

The positive consequences of recognizing that lay citizens are non-experts can be seen in the operation of the citizen juries described above. First, because the political phase is concerned with the framing of the debate within the technical phase and developing the appropriate societal response to that debate, the role of citizens is to articulate how scientific and technical innovations are evaluated from a vantage point outside the established institutions and organizations. It is for this reason that the convention that jurors should be non-specialists with regard to the topic being deliberated is usually adopted (see, for example, Renn, 1999; Wakeford et al., 2005). In practice, sampling is done through a combination of random sampling supplemented by more strategic attempts to include specific populations. While the citizens who are recruited to the jury will inevitably have some knowledge of science-in-general (Kerr et al., 1998a,b), their views would tend to be balanced within the group and, in any case, counter-arguments would be provided by the witnesses.

Second, because the jurors are recruited as non-specialists, and the aim is to produce an informed response, then citizen participation cannot be a mass exercise. This is partly because the standard models for mass participation, such as a referendum, will not promote the necessary debate for learning (Evans, 2004) while others models, such as the GM Nation? Debate, are undermined by the self-selection of participants (Horlick-Jones et al., 2004). But it is also because of the practical difficulties of acquiring the necessary expertise. Citizen juries demand regular commitments over a period of several months and it is difficult to see how this could be scaled up to include all citizens and, more problematically, all the controversies for which a citizen jury or similar forum might be relevant.[37] In such a context, the sampling of the citizen jury method is essential as it allows a representative sample of lay participants hear 'evidence' from a range of experts and analysts, themselves selected to represent a range of different views and stances, and then to render a judgement or judgements that stands as a legitimate representation of the concerns of lay citizens.[38]

While it is possible to discuss the change in citizen knowledge in terms of the kind of substantive expertise participants acquire, that is not the main purpose of the deliberation. Although one consequence of participation for those citizens who do participate is that they will become more informed about a specific issue, the aim of the jury is to contribute to the political judgements that should not be left to the expert communities acting alone. In other words, the purpose of citizen juries is not to enable the jurors to develop interactional expertise and become experts in their own right. Instead, it is to enable lay citizens to develop some appreciation of the technical, ethical and other issues involved in order to apply their

meta-expertise and *do* discrimination. Viewed in this way the purpose of citizen participation is far from marginal. The aim is nothing less than to (re)introduce democratically mandated preferences into the framing and conduct of the research activities that take place within the expert/technical phase. As the activist communities realize:

> What we need to get to is not a new politics of genetics, or human genetics, or whatever. It's the politics of new technologies ... I think we need to get past the naive idea, which is very intentionally propagated, that technologies don't have politics. As soon as you get to a recognition that they're created in the same way as a policy ... then we can move to a state where we can debate that and bring that under citizen control.[39]

Summary and Conclusions

By emphasizing the difficulty of separating facts from values, the STS literature has been highly effective in questioning the authority of science and highlighting its social commitments. Now, however, the problem is different: the choice is not so much between different knowledge claims as between the different sets of values and commitments they embody. In this paper, we have shown how distinguishing first between experts and non-experts and then between expert and democratic processes allows debates about controversial science to be analysed in a way that avoids the false oppositions created by the terms 'scientists' and 'publics'. Instead, we have argued that processes that support both expert critique and democratic scrutiny are necessary, but that they need to be separated if they are to remain true to their own distinctive, but very different, standards.

While this may seem to reintroduce the privilege given to science, examined more carefully it does nothing of the sort. Even if it is conceded that there are questions of fact that matter, and that these are best left to experts to investigate, this in no way exhausts the debate. Expert debates take time to resolve and invariably raise questions that are more accurately conceptualized as being moral or political in nature. These questions about risk and preferences are more appropriately addressed through institutional practices that seek to reduce the autonomy of science. Promoting diversity within expert debate at all stages of the innovation cycle thus increases the likelihood that questions about values and priorities will be raised. It does not, however, imply that experts alone should decide which values and priorities should be acted upon. Instead, it implies the exact opposite – that at some phases of the debate it is vital that non-experts are involved and that lay citizens are given the opportunity to exercise the common sense for which they are generally celebrated.

That said, however, it is important not to overlook that some subject-specific knowledge is necessary for lay common sense(s) to be applied meaningfully.[40] Thus, while we might expect that citizens are able to decode and evaluate the social, cultural or political stakes that are implicitly contained within debates that are ostensively framed as 'technical', we might also expect that their capacity to do this would be enhanced by some

additional information about how the competing claims were produced, who was making them and how others were critiquing them. In this way, citizens would be able to exercise their judgement not on a selection of material made available by the media or campaign groups, but on evidence that is selected according to criteria that put some notion of representativeness at the centre of the process. As can be seen, the counter-commonsensical claim is that the more individual citizens participate in esoteric science – that is, the more engaged they become – the less normal and ordinary they are. In other words, if citizens are to be free of prejudice and not co-opted by interest groups on either side, then the practical impossibility of significant public engagement with all the esoteric details of science is not a problem but a resource to be nurtured and used.

Notes

1. Lord May of Oxford, President's Anniversary Day Address, Royal Society, 2001. Quoted in Royal Society *Science in Society Report 2004*, p. 7.
2. One recent example of this is the area of nanotechnology, in which the 21st Century Nanotechnology Research and Development Act, which was signed by President Bush in December 2003, requires 'public input and outreach to be integrated into the Program by the convening of regular and ongoing public discussions, through mechanisms such as citizens' panels, consensus conferences, and educational events'. Source: <http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=108_cong_public_laws&docid=f:publ153.108> (accessed 6 January 2005).
3. More generally, there is now a substantial number of STS studies that have addressed the topic of public participation, usually through a focus group-based approach in which citizens are asked to give their views about a range of different sciences. At the 4S conference in 2005, for example, there were at least eight separate sessions on topics relating to public participation, governance and expertise, while at the joint 4S/EASST meeting in Paris in 2004 there were 38 sessions under the theme Expertise, Governance & Public Debate.
4. This is meant as a normative rather than descriptive question. It is clearly the case that, under current decision-making processes, certain types of knowledge are more equal than others (see, for example, Fischer, 2000; Irwin & Michael, 2003). Our concern here is with whether they should be.
5. In saying this we are therefore not making the distinction between 'contributory' and 'experiential' expertise introduced in Bal et al. (2004).
6. For a discussion of the different ways in which expertise is used within liberal democracies, see Turner (2001).
7. Although the example of science was implied in the paper, the approach applies equally well to expertise about cookery, Buddhism or driving a car.
8. Another way of phrasing this is to say that interactional expertise includes only those skills related to linguistic interactions, whereas contributory expertise would include practical and craft skills as well. More prosaically, interactional expertise means being able to 'talk the talk', whereas contributory expertise means being able to 'walk the walk'.
9. In addition to the cited work, the expertise theory has also been developed and debated with graduate students researching MMR (Boyce, 2005) and the GM Nation? Debate (Harvey, 2005), as well as in Evans' work on the euro referendum (Evans, 2004), Collins' debates with philosophers about the nature of interactional expertise (2004a,b) and in a series of imitation game experiments based on the Turing test (Collins et al., 2006).
10. See Healey (2004) for more on the idea of the scientific connoisseur. There are also some similarities with the Polanyi's (1958) emphasis on connoisseurship, but the

Collins and Evans usage differs in that it refers to the ability of non-practitioners to make judgements about the competence of contributory experts (for example, wine connoisseurs making judgements about wine-makers), whereas Polanyi uses the idea to emphasize the importance of examples and experience in developing a contributory expertise such as becoming a wine taster (see, for example, Polanyi 1958: 54–55).

11. Although expert/technical debates are being presented first, this should not be taken to mean that they are either chronologically prior to political/democratic debates or more important than them. The term 'phase' is perhaps unfortunate here, as it implies a time dimension, when it is being used in the physical science sense in which the same material (for example, water) can exist in several different phases (ice, water, steam) depending on the external conditions (temperature, pressure). See <http://en.wikipedia.org/wiki/Phase_(matter)> (accessed 21 October 2004) for more details of this concept, though readers may want to check that this entry is right, given the non-peer reviewed status of the encyclopaedia!
12. Epstein (1995) illustrates the point in some detail, while Shapin (1995) notes the same claim as part of the sociology of science more generally.
13. Although not ideal, one metaphor that might illustrate the underlying ideas is that, just as water shifts between solid/liquid/gas phases as a result of different combinations of temperature and pressure, so the focus of concern shifts between technical/political phases as a result of the differing degrees of knowledge, certainty and political stakes. Phrased like this, there are obvious similarities with the idea of post-normal science (Functowicz & Ravetz, 1993), although there are also some differences, notably in the idea of extended peer review, which would appear to erase the distinction between expert and non-expert that is central to our approach.
14. CESAGen is the ESRC-funded Centre for Economic and Social Aspects of Genomics. More information about CESAGen and its research projects is available at: <www.cesagen.lancs.ac.uk/> (accessed 13 November 2005).
15. It is often suggested that the idea of relevance is a problem. In some sense this is true, though it is only significant if the assumption is made that all relevant experts have to be identified in advance. Given the impossibility of predicting the future, what really matters is that the process remains open to the inclusion of new expertises as and when they become identified as relevant.
16. Interview with M1.
17. Interview with M1, p. 1–2.
18. Within the activist communities, however, there is some debate about the usefulness of this attempt to acquire scientific knowledge and the extent to which campaigns, particularly those that are motivated by more humanitarian or anti-capitalist agendas, are helped by this approach and its implicit acceptance of the scientific framing as the legitimate one.
19. See for example, GeneWatch Briefing 18, available online at: <www.genewatch.org/Publications/Briefs/Brief18.pdf> (accessed 20 October 2005).
20. Interview with A1, pp. 31–32.
21. Of course, it is important not to overdo the similarity between social movements and scientists. For example, whereas 'career experts' such as scientists typically have fairly smooth career trajectories, 'activist experts', as illustrated in the quotes above, often have fractured and multiple career paths.
22. For more on the ESSF and its activities see: <www.essfnetwork.org/index.html< (accessed 13 November 2005).
23. Interview with P1, pp. 18–19.
24. Interview with M1, p. 1.
25. Interview with M1, p. 28.
26. Interview with M1, p. 58.
27. Within STS there are several well-known attempts to put such ideas into practice and develop institutions that bridge the gap between technical and social knowledge. Examples of these include: Nowotny et al. (2001), Rip et al. (1996), Schot (1996/98), Grin et al. (1997) and Wilsden & Willis (2004).
28. Interview with ACT12, p. 4.

29. The deficit model in the Public Understanding of Science is usually associated with the UK Committee on the Public Understanding of Science, set up by the Royal Society in the mid-1980s. The aim of the committee was to improve the public perception of science. The approach is based on two assumptions. The first is that the public have a limited understanding of scientific issues – the deficit – and that this is the cause of their scepticism. The second is that providing scientific knowledge to fill the deficit will eliminate the scepticism and improve public confidence in a range of controversial scientific and technological domains. While it is probably true that many citizens do not have a detailed knowledge of science, the flaw in the deficit model is usually seen as being the uncritical acceptance that improving people's scientific knowledge will lead to an increase in support for the previously controversial science. For a review of the deficit model see Sturgis & Allum (2004)
30. At the time of writing, the UK's Committee on Radioactive Waste Management (CoRWM) is asking for public opinion on strategies for storing or disposing of radioactive waste. A discussion guide has been prepared and circulated to a range of community-based groups. In addition, interested citizens can order a copy of the guide and respond via the CoRWM website, which explains the process as follows:

    > The guide invites you to discuss the issues and report your comments to CoRWM. It is simple to use. It invites you, as a citizen, to weigh up the priorities in selecting a disposal or storage option from the shortlist – or a combination of options. It involves using the criteria and the wider ethical questions agreed in the 2nd round of consultation. It does not require specialist knowledge of nuclear engineering. Inputs from all the group discussions nationwide will be used to help inform CoRWM's recommendations to government. (Source: <www.corwm.org.uk/content-769>)

31. For a review of public engagement attempts, together with an assessment of the different ways in which they can be evaluated, see Rowe & Frewer (2004).
32. The criteria by which these participants were selected is described in the GM Nation? Report as follows:

    > The sample was constructed to give broad coverage across the general public population. Thus, four broad life stage and two broad socioeconomic groupings were adopted, while the locations gave broad geographic coverage of the United Kingdom, including Scotland, Wales and Northern Ireland. This sample construction has been used successfully on many previous projects and has been shown to provide a good understanding of the public's views and levels of engagement with various complex issues. A total of 77 people took part. (Department of Trade and Industry, 2003: 36)

33. In this particular jury it seems that the oversight panel selected the experts and thus set the programme in advance. Other citizen juries, particularly those that follow the consensus conference model more closely, also allow the jurors to select witnesses and experts.
34. A similar role for lay citizens can also be found in the democracy of ancient Greece. In this case the 'Council of 500', which advised and supervised the Assembly, was comprised of 500 citizens, chosen at random from a list of nominations itself created to represent each of the ten 'tribes'. Although the mechanism of selection is different, the underlying principle that scrutiny by lay citizens is important and practical seems broadly similar to the position outlined in this paper. For a brief description of the 'Council of 500' see Fishkin (2002).
35. For example, when reporting on the results of the British Social Attitudes Survey, Sturgis et al. (2004: 132) write that, in response to the question that asked if people:

    > were interested in 'issues to do with genes and genetics', nearly a quarter (24 per cent) had 'a great deal' or 'quite a lot' of interest in the area, a quarter had 'some' interest, another quarter (24 per cent) 'not very much' interest, and 27 per cent had 'none at all'.

36. For example, in the case of the Cumbrian sheep-farmers, one element of the critique is that the scientists did not know how to look after sheep but did not listen to the

farmers, with the result that monitoring regimens and other experiments were badly designed and did not work.

37. We can see that being both informed and representative matters by imagining the alternative: if all that was at stake was estimating how many people would support a particular policy based on common knowledge, then an opinion poll based on a representative sample will give a reasonably accurate estimate. To the extent that we disagree with this approach, it must be because we are concerned with soliciting an informed opinion and recognize that it is important that participants are, in some sense, knowledgeable about the topic.
38. It has been suggested that using citizen juries in this way has some similarities to the Science Court idea piloted in the USA, but there are important differences. In particular, Science Courts were designed to resolve scientific controversy, and thus correspond (if anything) to the expert/technical phase of a controversial decision. The democratic/political decision-making of the citizen participants is not about resolving scientific uncertainty but deciding what would be an appropriate response when faced with conflicting scientific evidence.
39. Interview with M1, pp. 55–57.
40. For example, in the GM Nation Debate, there was a change in the attitudes of the Narrow but Deep groups as they engaged more with the material and issues. In this case, their attitudes tended to become more sceptical and cautious, negating a simple deficit model, though they tended to remain less hostile than those who actually attended the meetings.

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Robert Evans is a Senior Lecturer in Sociology at the Cardiff School of Social Sciences. He has recently finished working on a project evaluating a novel mechanism for promoting pubic engagement in science policy debates and, with colleagues in the Centre for the Study of Knowledge Expertise and Science (KES), he is researching the imitation game as a methodology for investigating expertise. He is the co-author, with Professor Harry Collins, of *Rethinking Expertise* (University of Chicago Press, 2007).

Address: Glamorgan Building, King Edward VII Avenue, Cardiff CF10 3WT, UK; fax: +44 29 2987 4175; email: EvansRJ1@Cardiff.ac.uk

Alexandra Plows is a Research Associate at the ESRC Centre for the Economic and Social Aspects of Genomics (CESAGen). Her research focuses on radical activist discourses, identities and networks and draws on social movement theory and ethnography, 'green' politics and feminist theory. Her latest work examines the emerging politics of stem cell research.

Address: 6 Museum Place, Cardiff University, Cardiff CF10 3BG, UK; fax: +44 29 2987 0024; email: PlowsA@Cardiff.ac.uk